CHAPTER 2

ECONOMIC ANALYSIS--AN OVERVIEW

I. General Types of Economic Analysis

The term economic analysis is a broad one. It encompasses a spectrum of topics including economy-wide analysis, regional studies, market structure investigations, and analysis of specific decisions. It is this last topic, as applied to FAA investment, regulatory, and certain grant award decisions, that is the topic of this handbook. Such applications usually concern the addition or subtraction of a particular investment or regulation to the existing system or body of regulations--denoted as marginal or incremental analysis. For the most part, the methodology outlined is also applicable to the evaluation of a system in total or a body of regulations.

Economic analysis of investment and regulatory decisions seeks to provide answers to two economic questions: (1) is a particular objective worth achieving, and (2) which of several alternative methods of achieving an objective is best? Two general procedures are employed to answer the questions. The first, cost effectiveness analysis, assumes that the first economic question has been answered in the affirmative and concentrates on providing an answer to the second question of which alternative is best. The second, benefit-cost analysis, seeks to answer both questions. While benefit-cost analysis is more complete than cost-effectiveness analysis, studies are often limited to the latter because of an inability to measure benefits in dollars.

A. Cost Effectiveness

There are two types of cost-effectiveness analysis: (1) least cost studies, and (2) constant cost studies. Least cost studies are appropriate where the level of effort is undetermined and relatively unconstrained but the level of output/benefits is fixed. The procedure concentrates on identifying the least expensive way of producing a given amount of a certain output. The analysis typically begins with a statement of a required objective. Alternative methods of achieving the requirements are then defined. Costs are estimated for each alternative and the least cost alternative identified.

Least cost studies are frequently undertaken when the decision has already been made to produce a given amount of the output in question. Examples of such situations are when a requirement for the output is established by administrative or legislative direction, when the output is required to support another program which is required, or when deciding

whether or not to replace existing equipment with new, cheaper-to-operate equipment which produces the same output. In all such situations, the analysis is confined to answering the question of how to produce.

Constant-cost studies are appropriate in situations where the level of output/benefits is undefined but the budget/resources available are fixed. The purpose of the analysis is to identify the outputs of each of a number of equal cost options and then decide which of the alternatives is best for producing the determined level of outputs/benefits. Such a situation typically arises where an agency is allocated a given amount of funds and directed to pursue a particular objective. The analysis permits the agency to determine how to produce the maximum amount of desired output/benefits with the given funds.

Analyses of this type require that outputs be measured in some way. If only one output is involved, the measurement can be in any convenient albeit arbitrary unit. If more than one output is involved, a unit of measurement applicable to all units is required. If no such unit can be found, the study must of necessity be confined to a description of the outputs of the various alternatives. Judgments as to the relative importance of each separate output are then left to the policymaker.

B. Benefit-Cost Analysis

Benefit-cost analysis seeks to determine whether or not a certain output shall be produced and, if so, how best to produce it. It thus goes beyond the limited objective of cost-effectiveness analysis of determining how best to produce. Benefit-cost analysis calls for the examination of all costs related to the production and consumption of an output, whether the costs are borne by the producer, the consumer, or a third party. Similarly, the method requires an examination of all benefits resulting from the production and consumption of the output, regardless of who realizes the benefits. Because the ultimate objective of benefit-cost analysis is the comparison of benefits and costs, they both must be evaluated in the same unit of measurement. It is rare that anything other than dollars (or another monetary unit) proves to be satisfactory.

The benefit-cost procedure requires that alternative methods of producing the output be identified. The benefits of each alternative are then valued in dollars and compared to their expected costs. That alternative for which benefits exceed costs by the greatest amount is identified as the project alternative to be undertaken. The action is worth taking because benefits exceed costs. It is best because benefits exceed costs by the greatest amount. Unfortunately, such studies often experience difficulty in the identification and valuation of benefits. Governmentally produced outputs (or outputs required to be produced by regulation) are usually not sold under market conditions making it difficult to determine their value to consumers and the benefits they may provide to the rest of society.

II. Economic Analysis Process

The economic analysis process consists of nine steps:

1. Define the Objective
2. Specify Assumptions
3. Identify Alternatives
4. Estimate Benefits and Costs
5. Describe Intangibles
6. Compare Benefits and Costs and Rank Alternatives
7. Evaluate Variability of Benefit-Cost Estimates
8. Evaluate Distributional Impacts
9. Make Recommendations

The analytical considerations involved in each of these steps are described as follows.

STEP 1 - DEFINE THE OBJECTIVE

The analysis cannot proceed until the exact objectives of the project or regulation under consideration are precisely stated. Moreover, any project or regulation actually undertaken without a clear understanding of the desired outcome is likely to be inefficient and, perhaps, unnecessary. The objective should be stated in terms of desired outputs of the project or regulation. It is a common failing to describe an action in terms of the inputs required to accomplish it. For example, the objective of providing airspace surveillance should be stated in terms of the expected improvement in benefits--enhanced safety, increased system capacity, reduced costs, better weather detection, etc.--rather than as a need to procure a new radar system.

In some situations the objective will be specified by external authority. For example, either the executive or legislature may mandate that a particular objective be pursued. The analyst's role in such a case is limited to formulating a succinct statement of the mandated objective and clarifying ambiguities that may be present in it.

At times, several projects or regulations may be combined for administrative purposes. For analytical purposes, they should be separated and independently evaluated to the extent that their objectives are functionally separate. Functionally separate objectives are those which are independent of each other and do not depend upon common investments or regulations. For example, regulations pertaining to design requirements of different

types of aircraft should be considered separately. But regulations concerning flight time and duty time restrictions should be considered together because one interacts with the other. As to common investments, the separate objectives of safety and delay reduction should be considered together when they arise from a common investment such as an ASR and separately when they arise from separate investments such as an LLWAS (safety oriented) and PRM (delay reduction oriented).

STEP 2 - SPECIFY ASSUMPTIONS

Analysis of projects and regulations which will have most of their impact in future years involves a substantial amount uncertainty. In order to proceed, assumptions must frequently be made. For aviation investment and regulatory analyses, assumptions generally include aircraft fleet characteristics, levels of aircraft activity, equipment life, the number of passengers and/or shipment revenues, the cost of fatalities and injuries, and the value of passenger time. These should be explicitly identified and their basis--judgment, econometric forecast, etc.--clearly elaborated. Assumption specification often cannot be done exhaustively as a second step. Frequently, some assumptions cannot be specified at the beginning of a project. Others must be changed as the project proceeds and more information is obtained or information gaps appear that can be filled only by assumption.

STEP 3 - IDENTIFY ALTERNATIVES

There are normally several ways to achieve an end. It is important to identify all reasonable ways to achieve the desired objectives. This step is critical because only those alternatives that are identified will be evaluated. Any alternatives that exist but are not identified cannot be selected as the most efficient method to achieve the objective. In the absence of a sufficiently low cost alternative, the analysis that follows may determine that the objective is not worth undertaking since its costs exceed its benefits.

This step should not be interpreted to require that every conceivable alternative way of doing something needs to be included in the analysis. Many technically possible alternatives may be ruled out from the beginning as inferior to others which are being considered. This may occur in several situations. First, it may be well known that a particular approach is more costly than others, at least for the scale of activity under consideration. Second, it must be recognized that most investments or regulations build upon existing ones. Because new investments or regulations must mesh with existing ones, many potential alternatives which do not mesh can be ruled out. Note that this exclusion criterion is not applicable when considering the adoption of a new system or a functionally separate set of regulations or a replacement for existing ones. Finally, other cases may arise where it can be determined that one or more alternatives are inferior to the others before a formal analysis is undertaken. The analyst is cautioned that such determinations should be well founded and supportable. Moreover, while such exclusions will save analytical resources, care must be taken that viable alternatives--perhaps the best

one--are not excluded at this point. In particular, the analyst must not exclude alternatives merely because a predisposition exists in favor of others arising out of causes such as past practice or external constraints such as budget or personnel ceilings.

Successful alternative identification requires extensive knowledge of the production process or processes which can be utilized to achieve the objective. Such information is often highly technical and not confined to any single area of expertise. As a result, it is often necessary to enlist the aid of one or more technical experts at this stage of the analysis.

STEP 4 - ESTIMATE BENEFITS AND COSTS

This step requires that the value in dollars of all quantifiable benefits and costs be estimated. With respect to benefits, it is first necessary to determine the goods and services which the project or regulation can be expected to yield. Then, the value of these goods and services must be determined. For costs, the physical resources which the project or regulation will consume must be determined and their costs estimated. Guidelines for formulating benefit estimates are presented in Chapter 3. Procedures for cost estimation are contained in Chapter 4.

STEP 5 - DESCRIBE INTANGIBLES

A natural follow-on to quantification of benefits and costs is the identification and description of intangibles--those things which cannot be evaluated in dollar terms. Intangible considerations should be listed and described for the decisionmaker. If possible, a range in which a dollar value could be reasonably expected to fall should be reported.[1] Intangibles should not be neglected; it is very likely that they will be extremely important to the outcome of the analysis.

[1] Note that to the extent that a benefit or cost initially thought to be an intangible can be described with a minimum and maximum value and characterized by a probability distribution, it may be possible to treat it as a quantifiable item in the variability analysis described in Step 7 and Chapter 6 below.

STEP 6 - COMPARE BENEFITS AND COSTS AND RANK ALTERNATIVES

It is this step that provides answers to the economic questions of what objectives to pursue and how most efficiently to obtain them. It establishes whether or not benefits exceed costs for any or all of the alternatives, thus indicating whether or not the objectives should be undertaken. In addition, by providing a ranking of the alternatives it identifies which is the most efficient in achieving the objective. Criteria for making this comparison are enumerated in Chapter 5.

STEP 7 - EVALUATE VARIABILITY OF BENEFIT AND COST ESTIMATES

Because uncertainties are always present in the benefit and cost estimates used in the comparison of alternatives in STEP 6, a complete picture of the situation can best be presented only if this uncertainty is explicitly considered.[2] Techniques for doing so include sensitivity analysis, monte carlo simulation, and decision analysis. By utilizing these and other methods, it is possible to examine how the ranking of the alternatives under consideration holds up to changes in relevant assumptions and, given uncertainty, how likely it is that the project is or is not worth doing. Selected methodologies are presented in Chapter 6.

In addition to helping deal with uncertainty, such analysis also provides feedback within the economic analysis process. At this stage of the analysis, it is often necessary to change key assumptions, formulate additional alternatives, and/or revise methodology. The analysis is then repeated under these new conditions. Thus, the economic analysis process becomes an iterative one.

STEP 8 - CONSIDER DISTRIBUTIONAL IMPACTS

For many Governmental investments and regulations, the recipients of the benefits are not those who bear the costs. From an overall perspective, society's welfare is improved as long as all accepted projects and regulations have benefits in excess of costs. This is true because those who benefit could fully compensate those who bear the costs and still be better off. However, while the potential for compensation may exist, it may not occur, or it may require further initiatives to implement. If costs are imposed on parties who neither benefit nor are compensated, the impact will be inequitable. Benefit-cost analysis should identify gainers and losers of Governmental investments and regulations and whether

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[2] Such techniques are sometimes referred to risk analysis. It should be noted that techniques to evaluate the variability of benefit and cost estimates maybe separate and distinct from risk analysis conducted to assess problems the solution of which is the objective of the project or regulation.

gainers actually compensate losers. When benefits and costs have significant distributional effects, these should be analyzed and discussed. Procedures for undertaking this analysis are contained in Chapter 8.

STEP 9 - MAKE RECOMMENDATIONS

The final outcome of the economic analysis process is a recommendation concerning the proposed objective. Under a benefit-cost analysis there are two parts to this recommendation: should the activity be undertaken, and if so, which alternative should be selected to achieve it. For a cost-effectiveness analysis, one of two answers is provided: which alternative should be selected to achieve the objective or on what activities should a fixed amount of resources (e.g., budget) be expended so as to best achieve the stated objectives. Note that this step goes beyond STEP 6 in that it incorporates not only a comparison of alternatives but also information gained by the risk analysis and the iterative process. The entire economic analysis process is summarized in Figure 2-1.

FIGURE 2-1
ECONOMIC ANALYSIS PROCESS